to become thicker at the large end or to form a wreath around the top of the large end. The markings, which vary from black to sepia and brown on underlying shades of grey and slate-grey, are rarely discrete. The illustration shows how little the markings vary.

Twenty-one eggs average 27.3 x 17.3 mm., with a measurement range 25.3–29.0 x 16.5–18.3 mm.

SUMMARY

The habitat of the Rufous-tailed Weaver, *Histurgops ruficauda* of Tanganyika is described.

Habits, behaviour, call, abundance and flock size are all mentioned.

There are details of the eggs and nests; favourite nesting trees are identified, as are also the grasses of which the nests are composed.

The Superb Starling, *Spreo superbus* lays in the old nests of *Histurgops*, in which quantities of the Fischer's or Orange-faced Lovebird, *Agapornis fischeri* also commonly roost, both by day and night.

Nest colonies are occupied by *Histurgops* throughout the year but the breeding season is brief.

A large grey hawk has often been seen harrying the *Histurgops* colonies.

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An ecological investigation of the Giant Pied-billed Grebe, *Podilymbus gigas* Griscom

by Anne LaBastille Bowes

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One of the rarest waterbirds in the Western Hemisphere is the Giant Pied-billed Grebe, *Podilymbus gigas*, of the Guatemalan highlands. The species occurs only on Lake Atitlan (1555 metres) and numbers no more than an estimated 200 individuals.

The author and her husband, C. V. Bowes, Jr., became interested in these grebes during several Guatemalan trips in connection with their Caribbean Wildlife Tours. It was soon evident that local residents were ignorant about the species and that the birds were subject to shooting. egg-stealing and some natural predation. Nothing could be found on its life history, nor had there been any mention in the literature since 1936.

Consequently, in March, 1960, the Bowes, Jr., with Jorge Ibarra, Director of Guatemala's Museum of Natural History, and Father Juan Manuel, priest of Panajachel, spent four days censusing and photographing the Atitlan grebes by boat. A total of 99 birds was seen along

the more than 100 kilometer shoreline. We believe that twice this number were actually present on the lake, indicating the population had remained fairly stable since Griscom's count of 100 pairs in 1930 and Wetmore's of 1936.

Although the Giant Grebe was collected by Salvin and Godman in 1862, the bird was not recognized as a distinct species until 1929. Griscom and Crosby named it and made the first population estimates. Wetmore (1941) corroborated these findings in 1936. In October, 1962, the *Auk* carried a General Note by the present author.

In May, 1963, we received a grant from the International Council of Bird Preservation and the World Wildlife Fund with which we spent one month of intensive study at Lake Atitlan. The investigation was based on description and measurements, food habits, non-reproductive behaviour, reproductive behaviour, limiting factors and conservation education.

DESCRIPTION AND MEASUREMENTS

The original ancestor of the Guatemalan grebe was undoubtedly that of *Podilymbus podiceps* (L) a widespread polytypic species. Today the two species are entirely allopatric. The Giant Grebe still resembles *P. podiceps*, but it is nearly twice the size; its wings are small and weak, coloration is darker and the pied mark is distinctly black on a large white bill.

Weights and measurements of three Giant Grebes

	Juvenile female (*age* 4 *to* 8 *weeks*)	*Adult female*	*Adult male*
Weight	236.0 grms.	584.0	804.5
Wing length right	240 mm.	267	283
Bill, culmen to base	21 mm.	21	25
Tail	45 mm.	45	50
Mid toe with claw, right	54 mm.	67	80
Tarsus, left	32 mm.	42	48
Total length	385 mm.	457	525

Juveniles are greyish-brown with indistinct pied marks. Bellies are silvery-white with grey flecks on sides; backs are much darker brown.

Unborn chicks close to hatching are almost black with 3 or 4 longitudinal stripes of white running down back, from head to tail. Belly is lighter brown and streaked. Pied mark is distinct on a stubby whitish bill. Lores are pink.

Food habits

The Atitlan grebe is primarily a fish eater. It feeds during early morning and late afternoon in beds of *Chara*, *Potamogeton* and *Eichornia* which grow close to the precipitious shoreline. Of 35 timed dives, both sexes averaged 20 seconds under water. Stomach contents of four specimens included small fish (grebes can accommodate fish up to 15 cm. long), balls of feathers, pebbles (one of pumice), a snail (1½ cm.) and insect remains.

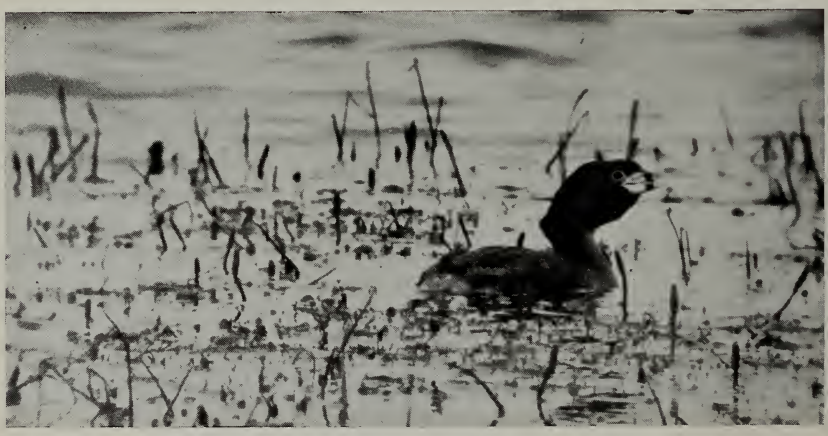
Potential food fish in Lake Atitlan are:
*_Cichlasoma nigrofasciatum_=zebra-backed cichlid
Cichlasoma sp.=3 species of mojarras
Tilapia mossambica=tilapia
Mollienisia sphenops=pescadito
Profundulus guatemalensis=gulmina=characin
Astyanax sp.=pepesca=killifish
Poecilistes sp.=pupo=top minnow
*one record exists of this fish found inside a grebe.

When a bird catches a fish, it immediately looks around and swims for deeper water. This seems to be a safeguard against food-snatching, a common practice among mates and juveniles. We also observed a young grebe pecking at *Typha* stalks where aphids and dried-up helgrammite cases were attached. Other possible food items could include dragonflies and other insects, leeches, water spiders and crabs (*Potomocarcinus guatemalensis*). No pellet casting was noted in wild or captive birds.

Non-reproductive behaviour

A special effort was made to determine whether the grebes are capable of flight. During a total of 150 hours observation, we saw birds run across the water, flapping their wings violently, but never becoming airborne. We named this "Patter-flight". Upon dissection of the pectoral muscles, it was found that *P. major* was well-developed while *P. minor* was small. The ratio averaged 8:1 in grams. Adult grebes weigh between 500 to 900 grams usually, yet their wings are small. The total wing area of an 805 gram male was 414 sq. cm. The author concluded on the basis of field observations plus laboratory data that Giant Grebes are not normally capable of flight. Against a strong wind, it is possible that a bird might briefly fly.

The species swims and dives with ease. The farthest distance covered underwater was 100 meters. Females showed a tendency to submerge sooner than males when alarmed. Excellent control of their specific



Male Giant Pied-billed Grebe giving territorial call.

gravity allows the birds to float at whatever level they choose. One juvenile however, had trouble in staying under water. Five types of dive were noted: working, alarm, power (aggressive), patter-plunge (escape) and ducking (courtship).

Non-breeding birds spend most of the day sleeping and preening in the shelter of waterweed, reed or cat-tail beds. This vegetation effectively breaks the rough waves which begin after mid-day due to strong mountain winds.

The sleep position, as described by Simmons (1955), is the "pork-pie" attitude.

The calls of these waterbirds are varied and often lead one to a direct diagnosis of their reproductive state. Five different vocalizations were heard: "Pok" (announcement call), "Creaking pump groan" (location call), "chu-chu" (advertising), "hen-flicker" (recognition chatter between mates), and "gulping cow" (territorial call). The latter two were taped and sent to Cornell's Laboratory of Ornithology. During full moon, we spent all night in our boat and heard considerable vocalization by paired birds.

Reproductive behaviour

Observations were made on three separate groups of grebes, each in different stages of breeding. The birds are loosely colonial and build their nests and platforms in the densest stands of *Typha* and *Scirpus* available. One single pair in early courtship stages occupied an area 3 km. long and ½ km. wide along rocky shores with only two skimpy reed beds. Normally, courting pairs have a territory about 200 m. along the shoreline and extending 50 to 100 m. out into deep water (7 m.). Beyond this "line" no territorial disputes were ever observed.

"Forward Threat" display (after Simmons) was a common form of mild aggressive behaviour, while "bridling dog" display was more intense. This might last for five minutes, during which time the two males would pivot, preen, bridle and puff along their invisible boundary line.

"Swimming together" (after Simmons) was noted very often between mated grebes as were body-shaking and head-shaking. Unfortunately, we were unable to see any platform building, soliciting, copulatory or nest-relief behavior due to the density of reed-beds and wariness of the grebes.

A number of platforms were found, usually after hearing continued "hen-flicker" calls from one location. Often, two were placed within 50 feet of each other. Aquatic weeds, dead reed stalks and cat-tails were utilised, yet construction was slipshod. Platforms measured about 30 cm. across and stood only 3 or 5 cm. above water.

Despite a most thorough search along the shoreline, only one nest was found. The birds themselves gave us a clue because of their systematic feeding routine, extreme wariness and continual territorial calls by males.

The nest was located about 70 m. from shore in 2 m. of water. It was built around a stout reed stalk and had a diameter of 38–40 cm. Height above water was 13 cm. The structure was solidly built of various aquatic vegetation and contained five eggs in its shallow depression. This is the first report in the literature.

The eggs were odourless, oval, smooth and stained a dull, mottled brown. They measured 51 mm. long, 33 mm. wide with a circumference

at the middle of 102 mm. The clutch was discovered on 2nd May and appeared to be 14 to 20 days old. The oldest egg contained a downy chick within 2 to 4 days of hatching.

From this find and reports of two or three conscientious residents, grebes have been seen with eggs or downy young on the following dates:

May 2	5 eggs near hatching
June, late	2 chicks on parent's back
Dec., early	4 chicks with 2 adults
	2 chicks with 1 adult
April 4	6 chicks with 3 sets of parents

It seems likely that two peaks exist in grebe reproduction, namely Nov.-Dec. and April-May-June. It is also possible the birds could nest at any time of year, as is the case with *Podilymbus podiceps* in Cuba (Gross, 1949).

A pair of Giant Pied-billed Grebes resting in patch of water weeds (*Chara*, *Potamogeton*, etc.)

During this investigation, we had the opportunity to capture two juvenile birds, aged 4 to 8 weeks and 2 to 4 months. This gave us the chance to note plumage, behaviour and vocalization. Unfortunately, both died within four days of spasms, convulsions and strangulation. It is assumed they were suffering from hypovitaminosis. Perhaps our diet of raw fish did not supply the needed vitamins, or supplied too much thiaminase which can lead to severe enzymatic disturbances (Suomalainen and Philgren, 1955). Both birds were very emaciated upon capture.

Limiting factors

Natural threats are few since mammalian predators are rare in the lake basin and birds of prey and snakes are scarce. Most dangerous to chicks, juveniles and adults are the small- and large-mouth bass introduced into

Lake Atitlan in 1957. From local reports plus the condition of our two young grebes, the authors believe bass are serious predators on the downy chicks and compete directly with juveniles and adults for food. Bass of seven pounds are not uncommon and their predatory nature is well recorded. The author examined 18 bass intestines and found small fish, crabs, leaves and beetle larvae.

The second greatest peril to the grebes comes through human predation and interference. Indians often shoot the birds with sling-shots and steal their eggs. Resident and visiting "sportsmen" also hunt with shot-guns.

Other limiting factors include reed cutting by Indians which reduces nesting and cover sites, real estate development, motor-boating and changes in water level. We feel it is remarkable that the grebes are surviving under the present increasing threats of bass and humans. Indications are that the birds are declining in numbers.

Conservation education

Despite the recent establishment of a waterfowl refuge on Lake Atitlan by the Guatemalan Government, in January, 1959, hunting and molestation of the grebes continue. During our March, 1960, census of birds, we stopped in five Indian villages to explain the rarity and the need for conservation. This programme was continued during the present investigation. New posters were printed and erected, a radio tape in four languages was prepared for broadcast and a number of television and press releases given.

Six specimens and five eggs (nest was deserted) were collected and sent to various scientific institutions. A short colour film and many photographs were taken. An estimate and plan for year-round protection of grebes was submitted to the International Council for Bird Preservation and to Carlos Humberto de Leon, Minister of Agriculture in Guatemala.

If funds could be found, we believe the Guatemalan Minister would co-operate fully with game wardens and equipment. Twelve hundred dollars would cover four wardens during the four peak reproductive months and permit the services of a biologist for one or two months a year. We are convinced that the Giant Grebes are declining in number and need immediate protection. There is ample room for further scientific investigation, conservation enforcement and education. Every effort should be made to save these rare waterbirds.

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